Instructor Information

—for ENG 1460: Introduction to Thermal Sciences

1. Term and Section

Term: Winter term (January–April, 2010)
Section: A03
CRN: 22706

2. Instructor Information

Instructor: Dr. Bing-Chen Wang
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Tel: (204) 474-9305
Fax: (204) 275-7507
Office: E1-410
Office hour: MWF afternoon, 1:00–2:00PM.

3. Lectures and Tutorials

MWF: 11:30AM–12:20PM
Room: E2-110

4. Laboratories

Friday: 3:30–5:20PM
Room: E2-130

5. Objective

The objective of this course is to provide a solid grounding in the theory of engineering thermodynamics. The emphasis is on the fundamental concepts (such as temperature, pressure, internal energy, work, heat, enthalpy, and properties of a pure substance), first and second laws of thermodynamics, and engineering applications of thermodynamics. It is expected that the students are challenged in terms of their understanding of the physical concepts, their related mathematical and engineering skills, and most importantly, their passion for studying thermal sciences and engineering.

6. Evaluation Method

The performance of a student will be evaluated based on their assignments, class discussion, two term tests and final examinations. Specifically, the mark distribution follows:

Distribution	**Value***	**Date***
Laboratory Assignments	10%	Weekly
Term Test 1	20%	Feb. 12
Term Test 2	20%	Mar. 12
Final Exam	50%	Set by Registrar, TBA

*Note: Term test dates and percentages are tentative and may change.

7. Tests and Examinations

• Term Tests and Final Examinations are **open textbook**. Additional sheets or notes are **not** allowed during terms tests and the final exam.
• Term Tests will be held during the normal "Laboratory" time, but the location may be different since the class may be split into two groups.

8. Class Discussion

In order to help the student to build a deeper insight into the physical problem and also to create a dynamic teaching–learning environment, some carefully-designed questions to the students will be included in the class. Students are encouraged to participate in class discussions by volunteering answers, even though their answers may be incorrect sometimes.

9. Laboratory Assignments Procedure and Policy

An assignment of selected textbook problems will be stated at the beginning of each laboratory session. Your hand-worked solutions to the problems assigned will be collected at the end of the laboratory session for marking. Solutions to lab problems done outside of the normal tutorial time and location will **not** be credited toward the assignment mark. You must attend the laboratory sessions and do the assigned problems during the session and in the assigned laboratory room.

10. Policy on Late Submission of Assignments and Research Report

A deduction of 25% of your mark will be applied per day if an assignment is late.

Solutions to all problems on the Problem List will be made available for review at an appropriate time on **JUMP** and also on the U of M libraries' **E-RES** system. If there is need, a hard-copy of the solutions can be made available in the Engineering Library in a course binder (available on reserve from the circulation desk). Solutions to the problems will normally be available after sufficient time has passed for you to attempt them either on your own or during the laboratory sessions.

11. Academic Integrity and Respectful Teaching–Learning Environment

Academic integrity and a respectful teaching–learning environment will be maintained in this class following the general policy stated in the University Calendar. Students must not engage in any unfair practice. In particular, plagiarism and cheating are not tolerated at University of Manitoba.

12. Teaching Assistants

Three TAs will be assisting us during the laboratory sessions and they are available for consultation throughout the course. TAs can be consulted by email and by arranging meetings with them. TAs will be announced later.

13. Reference Books

It is strongly recommended that a student have a convenient access to the following textbook:
Borgnakke, C. and Sonntag, R. E. 2009, *Fundamentals of Thermodynamics*, 7th ed., Wiley, USA.

14. How to Succeed in this Course

- Attend all lectures, laboratories and tutorials;
- Take lecture notes. Review and expend the lecture notes after each lecture;
- Participate in class discussions;
- Bring your textbook and handouts to the class;
- Keep up to date with the course material: after each lecture;
- Read the related material from the textbook and reference books;
- Solve all the example problems from the textbook and all those done in the lectures (**try them yourself, and thoroughly understand the concepts, theories and methods involved**);
- Solve the assigned problems from the list related to the current lecture material;
- Consult the Instructor and TAs regarding difficulties in understanding the course material;
- Be self-motivated and be passionate about the thermal-fluid science and engineering.

Course Coverage Outline

Borgnakke, C. and Sonntag, R.E.: *Fundamentals of Thermodynamics*, 7th edition, John Wiley & Sons Inc., 2009.

Chapter 1	Read this chapter for general interest and context.
Chapter 2	All sections will be covered.
Chapter 3	Sections 3.1 to 3.6 will be covered. Ignore the P versus T diagrams in Figures 3.8, 3.10, 3.11, 3.12 and 3.15; however the P-v and T-v diagrams in these figures are very important. Figure 3.22 and the related discussion on the compressibility of gases (the Compressibility Factor, reduced temperature and reduced pressure) can be ignored. Sections 3.9 and 3.10 can be read for interest.
Chapter 4	All sections in this chapter will be covered, except section 4.7 on Heat Transfer Modes.
Chapter 5	Sections 5.1 to 5.4 and sections 5.6 to 5.8 will be covered. Section 5.5 will be covered later with the Chapter 6 material. Consider only the case of constant specific heats in Sections 5.6 and 5.7, up to Eq. (5.29). Ignore the material following Eq. (5.29) to the end of Example 5.8 on p.151. Section 5.9 may be read for interest. Section 5.10 contains important conceptual information.
Chapter 6	Sections 6.1 to 6.4 will be covered. Section 6.5 on The Transient Process, and the related examples, will not be covered in this course. Section 6.6 contains important conceptual information.
Chapter 7	Sections 7.1 to 7.7 will be covered. The material in Section 7.8 is not covered, but Section 7.9 will be covered and Section 7.10 contains important conceptual information.

Note: This course will make use of the SI (Metric) system of units exclusively. Problems and examples in the text using English units may be ignored.

Format for Presenting Solutions to Thermodynamics Problems

1. It is required, for laboratory assignments, that you use engineering paper (green quad-ruled paper) which is available in the bookstore. Work only in the framed portion of the page (not in the margins). Work on one side of the paper only, and staple all pages together with your name and student number at the top of each page before submitting it at the end of each laboratory session.

2. Do the assigned problems in pencil (preferable) and clearly show your work. Neatness is very important for marking purposes. Marks will be deducted for poorly written or illegible solutions (in the opinion of the instructor or TA).

3. Units must be shown along with the physical properties obtained from the text. Units must also be shown along with major calculation steps and with the final answer. Marks will always be deducted for missing or incorrect units on assignments, tests and the final exam.

4. Draw a sketch of the physical system being considered (e.g., a piston-cylinder arrangement, a control mass, a control volume); also show phase diagrams indicating state points and process lines (when applicable); e.g., T-v (or T-V) or P-v (or P-V) diagrams with appropriate labels.

5. Write down important conceptual and numerical information that is stated in the problem, with all units. Record all relevant properties required for the system analysis.

6. When relevant, briefly state any simplifying assumptions needed to solve the problem and any conservation laws to be used (e.g., conservation of mass and conservation of energy).

7. The general procedure for solution details is to show (i) the equation, (ii) substitution of known values, (iii) calculation of a result, with units.

8. Do all of the problems in the list, not simply those that are to be handed in.

9. The general rule to follow for the number of significant figures to use is,
   (a) generally work with (carry) 4 to 5 significant figures;
   (b) record the full precision for values taken from the property tables in the text and use this full value in your subsequent calculations and when interpolation between table entries is required;
   (c) temperatures are expressed to, at most, two decimal places (e.g., 307.82 K or 34.67 °C).

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Problem List — Winter 2010

Text: "Fundamentals of Thermodynamics," C. Borgnakke and R. E. Sonntag
7th Edition, John Wiley & Sons Inc., 2009.

Chapter 2 Pressure, Volume, Temp.	**Chapter 3** Phases & Properties	**Chapter 4** Work and Heat	**Chapter 5** First Law - Control Mass	**Chapter 6** First Law - Control Volume	**Chapter 7** The Second Law Thermodynamics
2.30	3.27	4.21	5.17	6.12	7.15
2.31	3.32	4.22	5.20	6.22	7.17
2.37	3.34	4.25	5.21	6.23	7.21
2.39	3.35	4.26	5.27	6.28	7.22
2.40	3.36	4.27	5.37	6.31	7.26
2.46	3.37	4.30	5.44	6.33	7.30
2.51	3.38	4.33	5.46	6.40	7.31
2.54	3.44	4.34	5.51	6.44	7.32
2.62	3.45	4.35	5.55	6.45	7.33
2.64	3.52	4.38	5.58	6.48	7.38
2.65	3.54	4.42	5.61	6.52	7.42
2.71	3.56	4.43	5.70	6.59	7.47
2.72	3.57	4.51	5.73	6.65	7.51
2.74	3.59	4.52	5.77	6.68	7.54
2.75	3.70	4.54	5.79	6.71	7.58
2.77	3.76	4.59	5.82	6.74	7.62
2.80	3.80	4.64	5.84	6.80	7.69
2.84	3.112	4.66	5.85	6.82	7.70
	3.113	4.67	5.110	6.83	7.76
	3.125	4.72	5.113	6.85	7.79
			5.115	6.87	7.80
			5.120	6.89	7.87
			5.122	6.93	7.99
			5.132	6.95	7.101
			5.133	6.97	7.102
				6.103	7.107
				6.105	
				6.108	
				6.109	

Notes: Students are responsible for all problems in the list. Many of these problems will be solved as examples during the lectures and tutorials or assigned in the laboratory sessions to solve as an assignment.